

The New England Complex Systems Institute (NESCI)

Summer School

June 8-26, 2009

Each week of the summer school is the equivalent of a one semester course in a one week format. They may be taken independently or consecutively. If desired, arrangements for credit at a home institution should be made in advance.

Week One - Complex Physical, Biological and Social **Systems**

Week Two - Complex Systems **Modeling and Networks**

Week Three - **Methods** for the Study of Complex Systems

See details below and online:

<http://www.necsi.edu/events/summer2009.html>

WEEK ONE

CX201: Complex Physical, Biological and Social Systems

Dates: June 8-12, 2009

Location: MIT, Cambridge, MA, USA

This course offers an introduction to the essential concepts of complex systems and related mathematical methods and simulation strategies with application to physical, biological and social systems. The course will particularly focus on the use of multiscale representations as a unifying approach to complex systems concepts, methods and applications.

Concepts to be discussed include: emergence, complexity, networks, self-organization, pattern formation, evolution, adaptation, fractals, chaos, cooperation, competition, attractors, interdependence, scaling, dynamic response, information, and function.

Methods to be discussed include: statistical methods, cellular automata, agent-based modeling, pattern recognition, system representation and informatics.

WEEK TWO

CX202: Complex Systems Modeling and Networks

Dates: June 15-19, 2009

Location: MIT, Cambridge, MA, USA

This course provides an introduction to building models of complex systems (physical, biological, social and engineering), and network architectures dynamic processes.

It will cover the basic construction and analysis of models including identifying what is to be modeled, constructing a mathematical representation, analysis tools and implementing and simulating the model in a computer simulation. Particular attention will be paid to choosing the right level of detail for the model, testing its robustness, and discussing which questions a given model can or cannot answer.

The study of networks will introduce the use of network topologies and the characterization of networks describing complex systems, including such concepts as small worlds, degree distribution, diameter, clustering coefficient, modules, motifs. Different types of network topologies and network behaviors that model aspects of real complex systems will be described including: modular, sparse, random, scale-free, influence, transport, transformation, and structure.

WEEK THREE

CX203: Methods for the Study of Complex Systems

Dates: June 22-26, 2009

Location: MIT, Cambridge, MA, USA

This course provides an introduction to mathematical tools for analysis of complex systems.

It will cover the basic construction and analysis of models including iterative maps, stochastic processes, markov chains, cellular automata, stochastic fields, Monte Carlo simulations, information theory, computation theory, scaling, fractals and renormalization, linear stability analysis, pattern formation, and mean field theory.

This course is designed to provide a foundation for mathematical analysis of a variety of models of complex systems, as a foundation for advances that are not possible with conventional calculus and statistics.

An advanced mathematical background corresponding to a junior or senior college level background in mathematics or physics is recommended for this week three course.

TARGET AUDIENCE

These courses are intended for faculty, graduate students, post-doctoral fellows and others who would like to gain an understanding of the fundamentals of complex systems, and develop methodological tools for conducting research in their respective fields.

Early registration deadline: Friday, April 17

Please be reminded that the deadline to register for the Summer school at reduced rates is Friday, April 17.

For more information and registration:

<http://www.necsi.edu/events/summer2009.html>

The New England Complex Systems Institute
24 Mt. Auburn St., Cambridge MA 02138, USA